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ABSTRACT

This study compares the teaching of problem-solving skills to preschool children in individual and group settings. Subjects were 8 girls and 7 boys of 3 years, 6 months to 5 years, 10 months of age who attended a university laboratory preschool. There were two experimental groups and one comparison group. Children were presented with a problem staged in their classroom and were encouraged to generate possible solutions, evaluate the solutions, and implement their chosen solution. A point system was used to compare children's performance of the problem-solving skills. Children who received no instruction earned successively fewer points in their five pretests. Three children increased the number of points they earned after they received group teaching, and seven increased their posttest scores after individual teaching sessions. Repeated opportunities to solve problems did not increase children's scores. However, when opportunities were combined with teaching, mean scores increased. Related materials are appended, including sample data sheets for recording children's solutions, a description of how problem-solving skills were taught, and a set of bar graphs illustrating research results. (RH)

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GENERATING, EVALUATING, AND SELECTING SOLUTIONS TO PROBLEMS: INDIVIDUAL VERSUS GROUP TEACHING FOR PRESCHOOLERS

by

Marie Elizabeth Summers

Submitted to the Department of Human Development and Family Life and to the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Arts.

Professor in Charge

Committee Members

PS 018 00

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April 6, 1988
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Marie

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Abstract

This study compares the teaching of problem-solving skills in individual and in group settings. Children attending a university laboratory preschool comprised the two experimental groups and one comparison group. The eight girls and seven boys ranged in age from 3 years 6 months to 5 years 10 months. A pretest-teaching-posttest-teaching-posttest design was combined with multiple baseline pretests. Children were presented with a problem staged in their classroom and were encouraged to generate possible solutions, evaluate those solutions, and finally implement their chosen solution. A point system was used to compare the children's performance of the problem-solving skills. The children who received no instruction earned successively fewer points in their five pretests. Three children increased the number of points they earned following group teaching and seven increased their posttest scores after individual teaching sessions. Repeated opportunities to solve problems did not increase the children's scores. However, when opportunities were combined with teaching, the mean scores increased.

Generating, evaluating, and selecting solutions to problems:

Individual versus group teaching for preschoolers

As inevitable as death and taxes, problems plague or challenge people all of their lives. We have developed many ways of managing the problems we encounter every day. We may ignore the runny nose that is the first symptom of a cold or we may run from a car accident leaving others to manage the situation. We may spend hours, days, or even years worrying about being too fat or too thin. However, most people feel that the best way to cope with any kind of problem is to solve it.

But how do we learn to solve problems? Are there specific skills that we learn? Do we learn them through repeated experiences or can these skills be taught? Is there a best way, or time in our lives, to learn these skills? Why do so many adults seem unable to solve problems at home and at work?

Business and industry have begun to address the need for competent problem-solvers by teaching groups of employees, both labor and management, to follow set steps and procedures to identify and solve problems in the workplace (Torrance, 1982; Adair, Fitzgerald, Nygard, & Shaffer, 1982). Although specific programs vary, they are basically group processes in which a problem is identified and defined; data are collected and analyzed; and possible solutions are generated and evaluated. Then one solution is implemented, reevaluated and the results are reported.

These skills can be used beyond the business world. A similar process of group problem-solving was taught to another group of adults under different circumstances. Reece (1986) reported teaching five problem-solving skills to mentally retarded adults in a group home setting. These persons used the skills to improve group relations and to help alleviate problems in the general management of the home.

Educators have also addressed the development of problem-solving skills in children of various age levels. This recent concern about the need to improve children's thinking skills is due, partially, to the report, A Nation at Risk (1983). Included in this report were a number of "Indicators of the Risk" which stated, in part, that many 17-year-olds do not possess the "higher order" intellectual skills we should expect of them. Many new methods (e.g., TV programs, computer programs, workbooks, kits, and mnemonic tricks) are now available to help junior and senior high school students develop their problem-solving skills (Brown, 1983).

Educators have also introduced new ways to use traditional school activities to teach these same skills. Specific books and insightful questions on their content led children of all ages to practice problem-solving (Brown, 1986). Children, young and old, were encouraged to solve problems during their experiences with creative drama (Heinin, 1988). These activities (enacting stories, making props and costumes, and presenting feelings or the meaning behind a proverb) offered opportunities for children to "seek

answers, push for new ideas, generate and explore solutions, synthesize information, and exercise imagination" (p. 8). Creative movement, or movement exploration, has always been based upon the children solving the problems posed by the teacher (i.e., "How many ways can you . . . ?" or "Show me how you can . . . .").

Even small children are now actively encouraged to solve problems during all parts of the preschool day. Goffin (1986) suggested several phrases that could be used by teachers to present problems to children in their activities (i.e., How many different . . . ?, Make up a . . . . , Using just . . . ., Is it possible to . . . ?). She also advocated offering materials without directions so that children could make up their own activities. But are these children ready for more than just "trial and error" problem-solving?

If so, are children of this age (3- to 5-years old) still so strongly dependent upon their perception of situations and events that they are unable to employ logical steps to solve problems, as was suggested by Piaget (Thomas, 1979)? Or if they could learn a process for problem-solving, would they learn more in a group setting (the design of most problem-solving programs) or in a one-on-one situation? In fact, is teaching really necessary for these youngsters or will they just naturally pick up on the most efficient way to solve their problems if given many opportunities to attempt to do so? These are the questions that led me to this investigation and that I have attempted to address.

This study combined elements of several of the above related research reports but with notable differences. Problem-solving strategies were emphasized in studies that targeted adults and older children, while multiple opportunities or practice solving problems was the emphasis with preschoolers. Based upon the premise that "thinking and problem-solving skills improve through instruction and practice" (Brown, 1983 p. 711), this study offered children several opportunities to practice solving problems and two different methods of instruction (group and individual). Although employers and teachers have indicated that problem-solving skills are important, and that teaching these skills is desirable, none of the related studies was structured in a way that could prove that the skills had increased after instruction. This study included an attempt to measure this change in skill level.

Method

Subjects

I used a three-step process to select 15 children for participation in this study. They attended the Regents Center Child Development Laboratory Preschools, a part of the Edna A. Hill Child Development Laboratory Center and Preschools at the University of Kansas. First, I administered an expressive language screening to 38 of the 55 children enrolled in the four classes of the preschool (Monday, Wednesday, Friday, a.m.; Tuesday, Thursday, a.m.; Monday through Friday, a.m.; and Monday through Thursday, p.m.). During this individual screening I asked the children to "tell me about" three

nonsensical pictures. I encouraged them to talk for 10 minutes. I recorded their descriptions and my comments on an audio-tape for later transcription. From these transcripts, I calculated the Mean Length of Utterance (MLU) according to the formula described by Dale (1976). Secondly, I grouped the children into categories by their MLUs: High (14.29 to 7.33); Medium (6.95 to 5.52); and Low (5.27 to 2.30). Third, I formed five groups of children, with one child from each of these expressive language categories in each group. The selections for these groups were also governed by the number of days each child was available for research sessions.

The 15 children selected for this study ranged in age from 5 years, 10 months to 3 years, 6 months with a mean age of 4 years, 8 months. There were eight girls and seven boys involved, with three groups composed of two girls and one boy and two groups composed of one girl and two boys, as is illustrated in Table 1.

Setting and Materials

Setting. The preschool consisted of a large classroom (see Figure 1) and adjacent fenced playground. Lockers, bathrooms, and storage space were located off a hallway outside the room. All of the testing and teaching sessions were held in the preschool classroom during outdoor time, the last 30 minutes (11:00-11:30 a.m. or 3:00-3:30 p.m.) of a 2 1/2 hour program. We worked on the problems from various spots throughout the room, usually sitting on the floor facing one another.

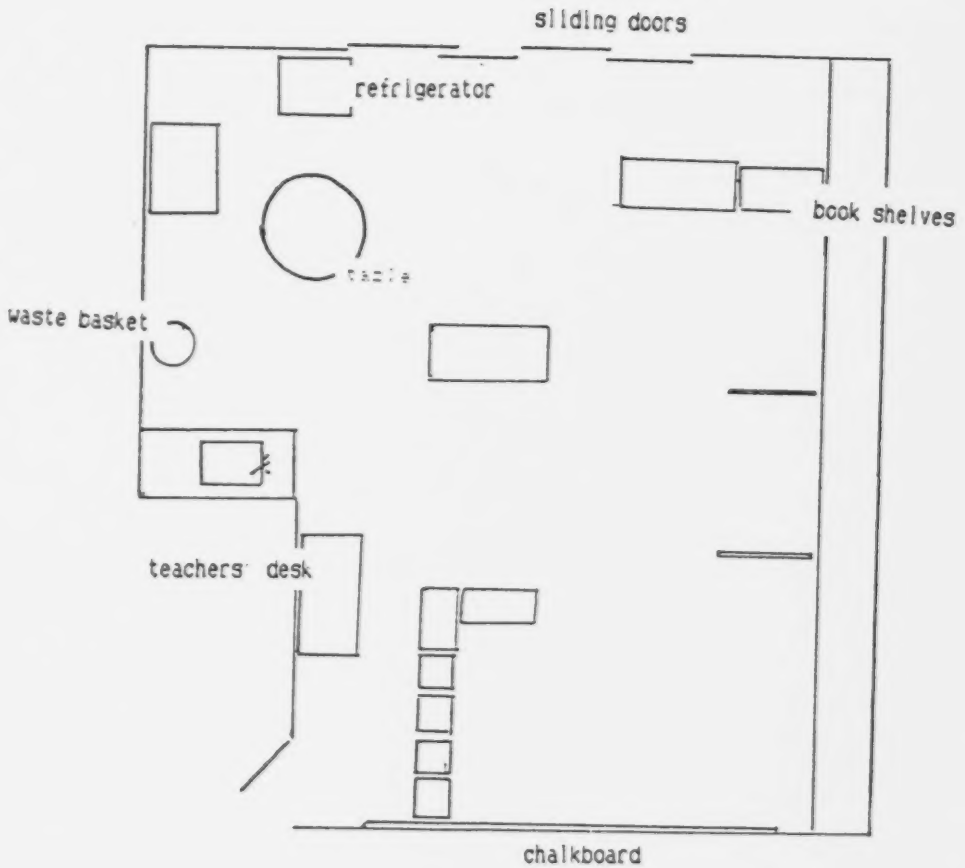
Table 1

Children Participating in Problem-solving Sessions

Group	Child	Sex	Age	Language Level (MLU)
Group Ia	Child A	Female	4-4	High
	Child B	Female	4-7	Medium
	Child C	Male	5-0	Low
Group Ib	Child D	Male	5-2	High
	Child E	Female	3-6	Medium
	Child F	Male	5-7	Low
Group IIa	Child G	Female	4-0	High
	Child H	Female	4-0	Medium
	Child I	Male	4-10	Low
Group IIb	Child J	Male	4-0	High
	Child K	Female	4-3	Medium
	Child L	Female	5-10	Low
Group III	Child M	Male	4-10	High
	Child N	Male	5-5	Medium
	Child O	Female	5-1	Low

Figure Caption

Figure 1. Floorplan of the preschool classroom including furniture and equipment used in the problems presented to the children. The playground was adjacent to the classroom and accessible through the sliding doors.


sliding doors
refrigerator
book shelves
table
waste basket
teachers' desk
chalkboard

Only the child or children involved in the session, a reliability observer (occasionally), and I were present. The other children in the class played outside on the playground just beyond the classroom's sliding doors.

Materials. The standard classroom equipment and arrangement were unchanged, with the exception of the few props necessary for the problem to be considered on that particular day. Table 2 lists the props used for each of the problems. I placed signs on both entrances to the room and the doors were locked to ensure that we would not be interrupted (see Appendix A for these signs).

I designed three data sheets on which to record the occurrence of all my instructions, prompts and praise to the children; the possible solutions that they generated; and the evaluation and implementation of these solutions. One data sheet was used for tests and the other two for individual and group teaching sessions, respectively (see Appendix B).

A large chart (Figure 2) was made to guide the children in evaluating the quality of the possible solutions that they generated for the problems. I taught the use of the evaluation chart during the teaching sessions only, but a chart was also available during each testing and teaching session. Line drawings, rather than words, were used on the chart to indicate the preferred and less preferred polarities for each of the evaluation criteria. Red and green markers were available during all sessions for use in this evaluation process.

Table 2

Problems Presented to Children

Problem	Props	Sessions Used
1. CAR There is a little car stuck under the refrigerator and we need to get it out.	Car placed under the edge of refrigerator.	Grp Ia-pretest Grp IIa-posttest Grp IIb-pretest
2. PAPER We need to get these two pieces of paper to stay together.	Two page class roster presented.	Grp IIa-pretest Grp IIb-grp teach Grp III-pretest
3. SANDWICH We want to make a peanut butter sandwich for each of us but we only have one slice (two for group teaching) of bread.	Napkins, knife, peanut butter, and bread placed on table with chairs.	Grp Ib-grp teach Grp IIa-pretest Grp IIb-grp teach
4. TRASH We need to throw away these papers but the waste basket is full.	Five or six sheets of newspaper crumpled on floor and newspapers crumpled to loosely fill the waste basket.	Grp Ia-grp teach Grp Ib-pretest Grp IIa-grp teach Grp IIb-ind teach
5. DOOR People shouldn't be using the door with the poster on it. What can we do to help people remember?	Curtain open enough so that the sliding door was visible.	Grp Ia-posttest Grp Ib-posttest Grp IIa-grp teach Grp IIb-ind teach
6. BOOKS We need to put all of these books on the shelves so that children can see the front of each one of them.	Sixteen books stacked on floor, no books on the shelves.	Grp Ia-ind teach Grp Ib-grp teach Grp IIb-pretest Grp III-pretest
7. COLD If you feel cold at school, what could you do to feel warmer?	No props needed.	Grp Ib-ind teach Grp IIa-ind teach Grp IIb-posttest Grp III-pretest
8. NOTE We need to figure out where to put this note so every mother or dad will be sure to notice it.	One page "note".	Grp Ia-grp teach Grp Ib-ind teach Grp IIa-posttest Grp III-pretest
9. CHALK We need to clean off the chalk mark at the top of the chalkboard.	One chalk line drawn about 6 1/2 feet above the floor.	Grp Ia-posttest Grp IIa-ind teach Grp IIb-posttest Grp III-pretest
10. WALKING How can we get from one side of the room to the other without walking?	No props needed.	Grp Ia-ind teach Grp IIa-pretest Grp IIb-pretest

Figure Caption

Figure 2. Evaluation Chart used by children. Symbols represent the preferred and less preferred polarities of the five criteria.

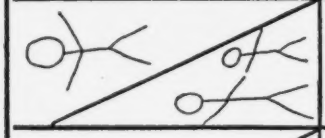
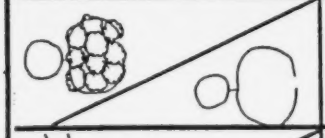
(a) Would it be safe or could someone be hurt?

(b) Do we have everything we need to do it this way, or do we need to get something more?

(c) Do you think you could do this all by yourself, or would you need a grown-up to help you?

(d) Would it take a short time or a long time to do this?

(e) Would this be pretty easy for you to do, or hard?

I made copies of written awards to present to the children at the conclusion of each session. These always included the child's name, the date, my signature, a two or three word description of the problem activity, a word or two of praise (i.e., Neat!, Fantastic Ideas!, Super Worker!), and a simple line drawing of an animal, child, or "monster". Examples are included in Appendix C. At the end of each child's final session, I gave a special colored award with a "scratch 'n sniff" sticker attached.

Observation and Recording

Observation Code. I began all testing and teaching sessions by introducing a problem to the children. Problem was defined as a teacher-stated task to be accomplished by the child(ren). (Refer back to Table 2 for problems.) Children then generated possible solutions, defined as a verbal description of any particular action that could be taken to solve the problem, regardless of the feasibility of that action.

During all sessions, I used verbal praise, non-verbal praise, neutral prompts and specific prompts as the child(ren) completed the steps toward solving the stated problem. Verbal praise was defined as any statement or word phrase from the teacher, directed toward the child, that showed approval of the child's response or action (e.g., "What good thinking!"). Non-verbal praise was defined as any teacher action, directed toward the child, that showed approval of the child's response or action (e.g., smiling, nodding). Neutral prompt was defined as a verbal acknowledgement of the child's response that

encouraged another response without providing any additional information (e.g., "Do you have another idea?"). Specific prompt was defined as a verbal encouragement for another response that provided suggestions of categorical actions, materials, or location of materials that might be used to solve the problem (e.g., "Can you think of something that would make you tall enough to reach the top of the chalkboard?").

During the teaching sessions, I taught the child(ren) the use of the evaluation chart to check the quality of each of their possible solutions using the criteria (refer back to Figure 2). The child(ren) determined, for each possible solution, whether to give a green or red check on each of the five evaluation criteria. A green check was defined as the preferred polarity for a criterion and a red check was defined as the less-preferred polarity. After evaluating all the possible solutions, the children selected the best solution. This best solution was defined as the possible solution having the most green checks at the end of the evaluation process (see Appendix D for the complete observation code).

Recording. I wrote the problem to be solved in the heading of the appropriate data sheet (Appendix B). As I gave each instruction, I marked a check (✓) in the space next to that instruction. I also recorded children's responses to these instructions in the same manner.

During the testing sessions, I recorded possible solutions on either the evaluation chart or my data sheet, per the child's

preference. After each of the testing sessions, I evaluated all of the possible solutions that the child had generated according to the same criteria used during the teaching sessions. On my data sheet, I recorded a check (✓) for each "green check" earned and a dash (-) for each "red check" on the line following each possible solution.

During all teaching sessions, the child(ren) or I recorded the possible solutions and the red and green evaluation checks on the evaluation chart. After each session ended, I copied all the possible solutions and evaluation checks from the chart to my data sheet.

I recorded verbal praise (V), non-verbal praise (N), neutral prompts (P), and specific prompts (S) throughout the sessions by circling the appropriate letters or noting and circling the letter in the margin of the data sheet. During the group teaching sessions, I recorded any evaluation criteria that the children discussed by indicating the possible solution number and letter of the criterion discussed (i.e., 2-E, 3-B). I also made various anecdotal notes in the margins and on the back of the data sheets both during and immediately following the sessions.

To compare the two teaching situations for the generation of possible and "best" solutions, I used the following point system to compile an overall score for each session:

One point for each possible solution offered;

One point for each green check from the evaluation process;

Five points for choosing a "best solution";

Three points for choosing a solution that

really solved the problem.

Thus, generating more, and higher quality, solutions led to larger scores, as did the use of the evaluation criteria to choose the best solution. I computed the points earned for each session and entered the total number of points on the data sheets. The children were not informed of this point system at any time.

Reliability. A reliability observer was present for 16 sessions, at least once in each of the experimental conditions. On data sheets identical to mine, she recorded all teacher behaviors, possible solutions generated, and the evaluation of those solutions performed by the children. Occurrence reliability was calculated on the number of solutions generated, evaluation of solutions (during teaching sessions), and teacher instructions. The formula for occurrence reliability was:

$$\frac{\text{number of agreements}}{\text{number of agreements + number of disagreements}} \times 100\% = \text{Reliability \%}$$

Overall reliability was calculated for the other teacher behaviors (prompts, specific prompts, verbal praise, non-verbal praise). The formula used to calculate reliability for each of these behaviors was:

$$\frac{\text{total number recorded by me}}{\text{total number recorded by reliability observer}} \times 100\% = \text{Reliability \%}$$

Experimental Design and Conditions

The experimental design of this study was pretest(s)/teaching/ posttest/teaching/posttest. This design required a total of 111 sessions during which problems were presented to the children. Six children (Group Ia and Ib) participated in seven sessions, one problem per session; six children (Group IIa and IIb) participated in nine sessions; and three children (Group III) participated in six sessions.

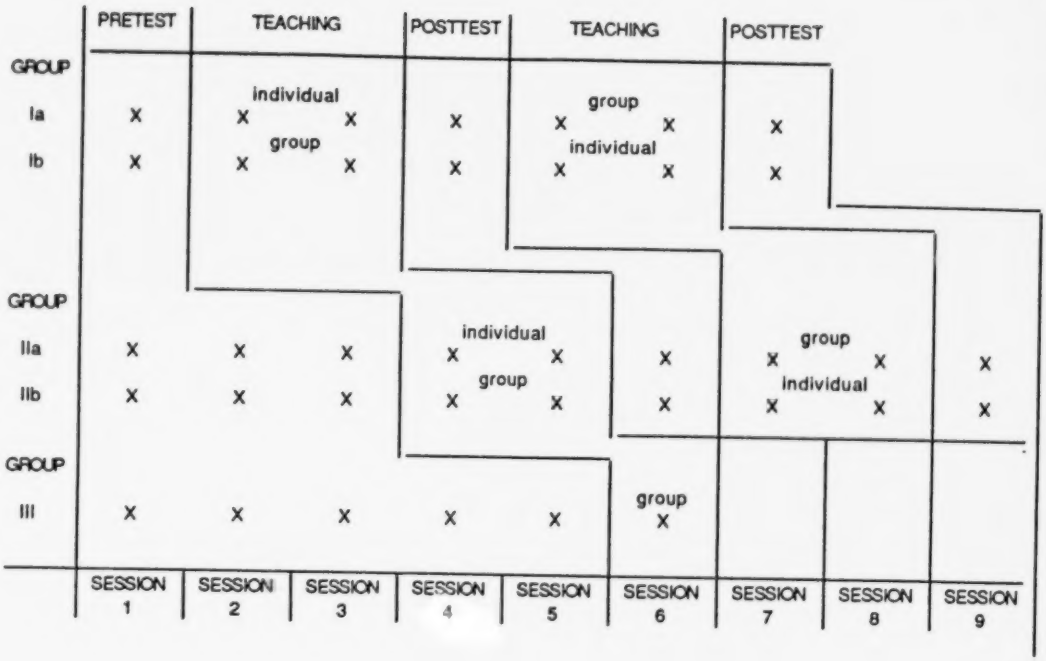
All pretests and posttests were administered to individual children. Two groups of three children (Group Ia and Group Ib) were given one pretest. Two groups of three children (Group IIa and Group IIb) were given three pretests. One group of three children (Group III) was given five pretests. This latter group served as a comparison group to determine whether repeated practice without teaching sessions would lead to the acquisition of these problem-solving skills.

Twenty-four of the thirty-two teaching sessions were held with individuals and the rest with groups of three children. The three children in Groups Ia and IIa participated in the individual teaching sessions first and then the group teaching. Groups Ib and IIb received the group teaching first followed by the individual teaching sessions. The three children in Group III participated in one group teaching session after their five pretests so that they could receive some of the benefits of the teaching sessions. A schematic drawing of this design is provided in Figure 3.

Figure Caption

Figure 3. Schematic drawing of the experimental design: pretest(s)/teaching/posttest/teaching/posttest.

EXPERIMENTAL DESIGN



During the pretest and posttest sessions, I presented the individual child with a specific problem and asked him or her to tell me as many possible solutions for that problem as possible. I offered to reread the possible solutions generated, offered the use of the evaluation markers, and asked the child to select the best solution for the problem from those generated. The child then implemented the chosen solution, received praise and a written award, and went outside to play.

During the individual teaching sessions, I again presented an individual child with a problem. I asked this child to generate possible solutions to this problem. I guided the child through an evaluation process using the evaluation chart and showed how to select the best solution by counting the number of green checks. The child implemented the best solution, received praise and a written award, then joined the class outside.

For sessions involving group teaching, I presented three children with their problem and encouraged each of them to suggest possible solutions. During the evaluation process, all three children and the teacher had to agree upon the color of check before marking each of the criteria for the possible solutions. It was necessary for the children to discuss many of these criteria before coming to a unanimous decision. They also had to agree upon the best solution before implementing it. Each of the children took part in implementing the solution, received individual praise and written

awards, and joined the class outside, or their parent(s) in the hallway, at the end of the sessions.

Procedures

Problems. I selected the problems presented to the children from a longer list of possible problems, following an evaluation by a group of graduate students in early childhood education and their advisor. These evaluators used the following criteria to judge the problems:

(a) problem is stated in terms understandable to the average preschooler,

(b) problem is environmentally embedded in the classroom,

(c) problem could be solved using at least three different solutions,

(d) problem could be solved using only materials found in the room (average preschooler has the knowledge necessary to use these materials), and

(e) solution to the problem could be accomplished in approximately two minutes.

Refer back to Table 2 for the problems presented to the children, the props used, and the sessions in which they were presented. Problems were assigned to sessions by using a table of random numbers.

Pretests/Posttests. During all pretest and posttest sessions, I presented a problem to an individual child by stating, "I have a job we

need to get done. Let's work together and figure out how to do it. This is our problem: (state specific problem)." I asked the child to repeat or paraphrase the problem to ensure that he or she understood. If the child did not repeat the problem, I would continue to repeat the problem or use open-ended sentences (e.g., "There is a little car stuck under the refrigerator and ...") to prompt for a statement of the problem until I was certain that the child understood the problem.

Next, I took out the evaluation chart and said to the child, "Now we are going to think of all the ways we could get our job done. You can use any part of your body, anything in our room, anything you can imagine to do this. I need to write down all of your ideas. Shall I write them on this big paper (chart) for you to see or on my little paper (data sheet) here?" If the child responded "big paper", I wrote the possible solutions on the chart. If the child chose the "little paper" or "your paper", I put aside the chart and recorded the solutions on my data sheet.

I then prompted the child to begin offering possible solutions by saying, "(Child's name), what is your first idea?" I wrote down each of the ideas that the child offered, giving verbal or non-verbal praise and general or specific prompts after some of these possible solutions. The verbal praise for the solutions generated was not differential in that none indicated more approval for one possible solution than for any other. After the child presented 10 possible solutions, after about 10 minutes passed, or after the child insisted

that he or she could think of no other possible solutions, whichever came first, we began the selection of the "best solution".

If the child had generated only one possible solution, I said, "You told me one way to do our job (specific problem and solution). Is this the best way you can think of?" If the child responded affirmatively, we proceeded to the implementation of that solution. If the child thought of another possible solution, we returned to the procedure for generating possible solutions.

If the child generated more than one possible solution, I said, "Now you need to decide which of these ways is the very best. You may use these markers if you would like. Do you want me to read your ideas to you again?" According to the response, I reread the possible solutions and/or allowed time for the child to use the markers on the evaluation chart or my data sheet, and then asked, "Which one of these is the best way to (state problem)?" After the child selected one of the solutions as best, I usually praised him or her, repeated the selected solution and said, "Let's see if it really works."

The child then implemented the chosen solution to solve the problem. If necessary, I gave assistance so that the problem was solved to the child's satisfaction. I ended the session by enthusiastically praising the child, presenting the child with a written award, and walking him or her outside to join the class for the remainder of the outdoor play period.

Individual Teaching. I used the same procedures for stating the problem and generating possible solutions as were used in the pretest/posttest sessions.

After I was certain that the child had offered as many possible solutions as he or she could, after 10 minutes, or after 10 possible solutions had been generated, whichever came first, we proceeded to evaluate these possible solutions. I said, "Now we are going to think about each of your ideas. We need to decide if we should go with the idea and give it a green check, or stop with the idea and give it a red check. One green check does not mean it is great and one red check does not mean that it is bad, but the checks will help us decide what idea is very best."

Together we evaluated each of the possible solutions against each of the criteria. I "read" the criterion, pointed to the symbols for the preferred and less-preferred polarities on the chart (refer back to Figure 2), and one of us made a red or green mark on the chart to indicate the child's response. For example, I asked, "Would it be safe or dangerous for you to drive a car across the room?" The child responded "Not safe!" and we would make a red mark in the first box next to that possible solution. After two or three solutions, I cued children to "read" the criteria by pointing to the drawings at the top of the chart. If, at any time, I felt the child was making an incorrect check, we would discuss the situation until one of us was convinced that the other was correct. In a very few instances, when the child would not agree with my assessment nor offer any "reason" for his or

her choice, I made the check that I felt was correct and we proceeded to the next criterion or possible solution.

To help the child select the "best" solution I said, "We have now checked out all of your great ideas. We need to figure out which one would be the best for you to do. Look at all of the checks on this paper! Remember, the green means ... (child responded 'go') and the red means ... (child responded 'stop'). Now you can count the green checks beside each of your ideas to find out which one is very best." I recorded the number of green checks for each possible solution as the child counted and then asked, "Which idea has the most green checks?" If necessary, we recounted the green checks until the child selected a solution with the most green checks as the best solution. If more than one possible solution had "the most" green checks, I asked the child to pick the solution that would be the most fun to do. Then I stated, "We have decided that the best way to (state problem) is for you to (state solution). Let's see if it really works." After the child implemented the solution we re-evaluated it: "Let's check our chart again. Was it really safe? Did we have everything we needed? Did you do this all by yourself? Did it take a short time? Was it easy to do? Did it really (state problem)?" As in pretest and posttest sessions, I gave the child praise and a written award before taking him or her outside to play.

Group Teaching. The procedures I employed in the group teaching sessions were very similar to those in the individual teaching condition. The group of three children and I discussed and ultimately

solved the problem presented. After presenting the problem to the group, I asked each child, in turn, to restate the problem. As they generated possible solutions, I offered each child the opportunity to share as many solutions as he or she could. They took turns but children could pass turns if they couldn't think of another possible solution.

Together we evaluated each of the possible solutions, each child responding after I "read" the polarities and pointed to the symbol on the chart. We discussed each criterion for a possible solution until the children agreed upon the color of check to make for each box. If we could not all agree upon the color of check for a criterion after the discussion, the teacher and majority decision determined the mark recorded. After this process of evaluation, the children counted the green checks to determine the best solution. It was necessary for the children to agree upon one best solution before implementing it. If more than one solution had the "most checks", I asked the children which one would be most fun. If they could not agree at this point, I wrote the number of each of the solutions being considered on small pieces of paper and had one child draw a paper from the pile. The children then implemented that solution, each participating in all or part of the implementation.

The children and I then used the chart to re-evaluate the chosen solution. I again praised each of them enthusiastically, gave them each a written award and took them to rejoin the class outside or to go home with their parents who were waiting in the hall. Because

group teaching sessions took longer to complete, the outdoor play period was often over and children were going home by the time we finished.

Results

The data from this study indicated that merely offering children more problems to solve did not improve their problem-solving skills (generating more possible solutions, evaluating the possible solutions, and selecting the best solutions). In fact, children who were presented several problems without instruction showed a declining ability to earn points and effectively solve the problems. This declining trend was reduced or reversed when children were given some type of instruction by the teacher. Further, more children in the experimental groups (Group I and Group II) increased their scores following individual teaching sessions than after the group teaching when three children worked with each other and the teacher.

However, these data also indicated that, when presented with the same problems to solve, the responses of individual children varied greatly. The number of possible solutions offered by the children ranged from one to ten (the maximum number allowed due to time restraints). When the total number of points earned during the problem-solving sessions were reviewed, six of the twelve children increased the total number of points earned on at least one of the posttests following their teaching sessions. Two of these children earned more points on both posttests than on any of their pretests.

Reliability

Occurrence reliability for the number of possible solutions generated during each of the 16 sessions observed was 100%. The evaluation of those solutions by the children during each of the 11 teaching sessions observed also showed a reliability of 100%. The reliability for teacher instructions ranged from 92% to 100% (see Table 3).

Overall reliability for four other teacher behaviors (general prompts, specific prompts, verbal praise and non-verbal praise) was also computed. This reliability ranged from 0 to 100% with 40 of the 64 calculations above 80% and 28 of those at 100%.

Group Data

Teaching vs. no teaching. Children participated in one, three, or five pretest sessions. The scores of children in these three groups indicated that those problem-solving skills targeted in this study actually decreased when more opportunities to solve problems were given without any teaching. Children who received five pretests, Group III, showed the greatest drop in average score (from 51.3 to 17.0 points, for a total of 34.3 points or 66.9%). Children in Group II participated in three pretests and their average scores also dropped (from 24.8 to 19.7, totalling 5.1 points or 20.6%). Following two teaching sessions, children in both Group I and Group II improved their average scores (.9 points, 3.8% and .8 points, 4.1% respectively). After two more teaching sessions, they again increased

Table 3

Reliability on Teacher Instruction and Generation and Evaluation of Solutions by Children

Condition/ Group	Teacher Inst.	Solution Generation	Solution Evaluation
Pretest/			
Group IIa	100%	100%	
Group IIb	100%	100%	
Group IIb	100%	100%	
Group III	100%	100%	
Individual Teaching/			
Group Ia	100%	100%	100%
Group Ib	100%	100%	100%
Group IIa	95%	100%	100%
Group IIb	95%	100%	100%
Group Teaching/			
Group Ia	100%	100%	100%
Group Ib	96%	100%	100%
Group IIa	100%	100%	100%
Group IIb	100%	100%	100%
Posttest/			
Group Ib	92%	100%	
Group IIa	100%	100%	
Group IIb	100%	100%	

the average points earned (Group I: 3.1 points, 12.6%, and Group II: 4.3 points, 21.0%). Figure 4 illustrates these results.

Teaching sessions: individual vs. group. The twelve children in the experimental groups (I and II) each participated in two individual teaching sessions (one child working with one teacher) and two group teaching sessions (three children working with the teacher). Typically, children earned more points during these teaching sessions than during any of their testing sessions.

Children earned even more points during group teaching sessions than during individual teaching. In fact, nine children earned their highest scores during one of their group teaching sessions and eleven of the twelve earned more points during one of their group teaching sessions than during either of their individual teaching sessions. The points earned by the children during these sessions ranged from 52 (Group Ib) to 26 (Group IIa) and averaged 36.5. The children generated an average of 5.4 possible solutions during the group teaching sessions.

The children generated an average of 4.8 possible solutions during the individual teaching sessions. The points earned by the children during these sessions ranged from 46 (Child F) to 14 (Child L) and averaged 29.3 (see Figure 5). The four children who earned their highest scores during sessions other than their group teaching session, earned these scores on posttests following their individual teaching sessions.

Figure Caption

Figure 4. Comparison of the average points earned by the children in each of the groups during testing sessions.

AVERAGE POINTS EARNED: PRETESTS AND POSTTESTS

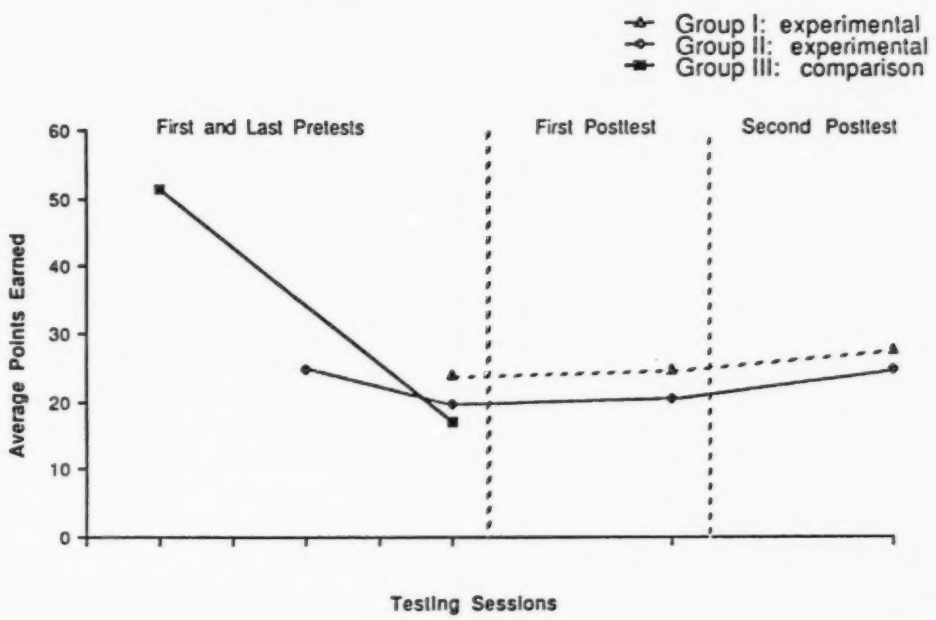
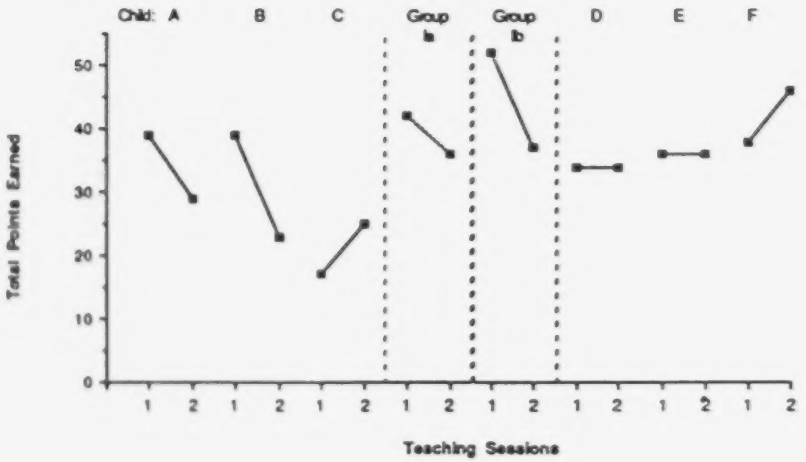
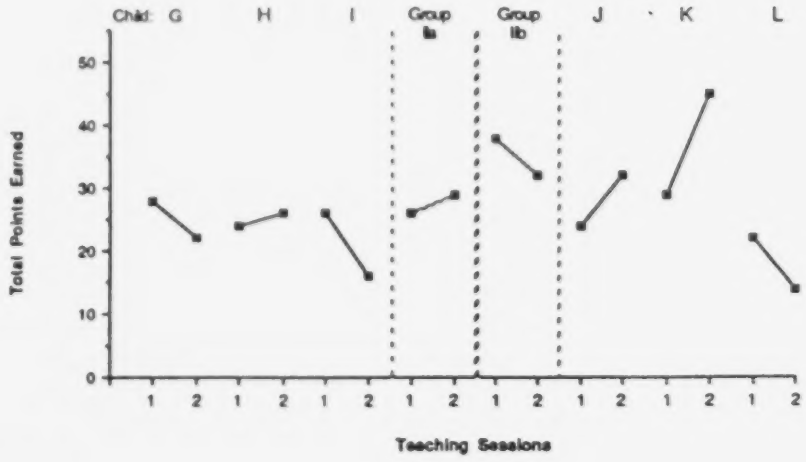


Figure Caption

Figure 5. Number of points scored by each child in the experimental groups (Group Ia, Ib, IIa, and IIb) during teaching sessions.

TEACHING SCORES:
INDIVIDUAL AND GROUP SESSIONS





Testing sessions: following individual vs. group teaching. Each child in Group I and Group II received both of the methods (individual and group) of teaching problem-solving skills. When the scores earned by the children before and after these teaching sessions were compared, the individual teaching method showed the greater average increase (5.7 points or 26.2%). In fact, following group teaching the children averaged 2.5 points, 10.3%, fewer points than they had before that teaching. Five children (Child B, D, H, I, and J) followed this trend of increasing their score following individual teaching and decreasing their test score after group teaching, as shown in Figure 6.

Testing sessions: following first vs. second teaching. The number of points earned by children in successive testing sessions was also reviewed. Figure 7 illustrates this comparison. The scores of the comparison Group III indicate that children earned fewer points on successive pretests when they did not receive any teaching for problem-solving skills. The scores of these children (M, N, O), when averaged, show a decrease of 66.9% from first to fifth pretest, as previously stated.

The averaged scores of children in experimental Group II, who received three pretests before any teaching sessions, also showed a decreasing trend. The pretest scores of this group of children fell from an average of 24.8 to 19.7 points. From this third pretest to their first posttest, their averaged score rose to 20.5 points, an increase of only .8 points (4.1%). The second and final posttest given

Figure Caption

Figure 6. Comparison of the change in total points earned by children in Groups I and II following individual teaching and group teaching, and the change in total points earned by children in Group III from their first to fifth pretests.

CHANGE IN TEST SCORES: FOLLOWING INDIVIDUAL AND GROUP TEACHING CONDITIONS

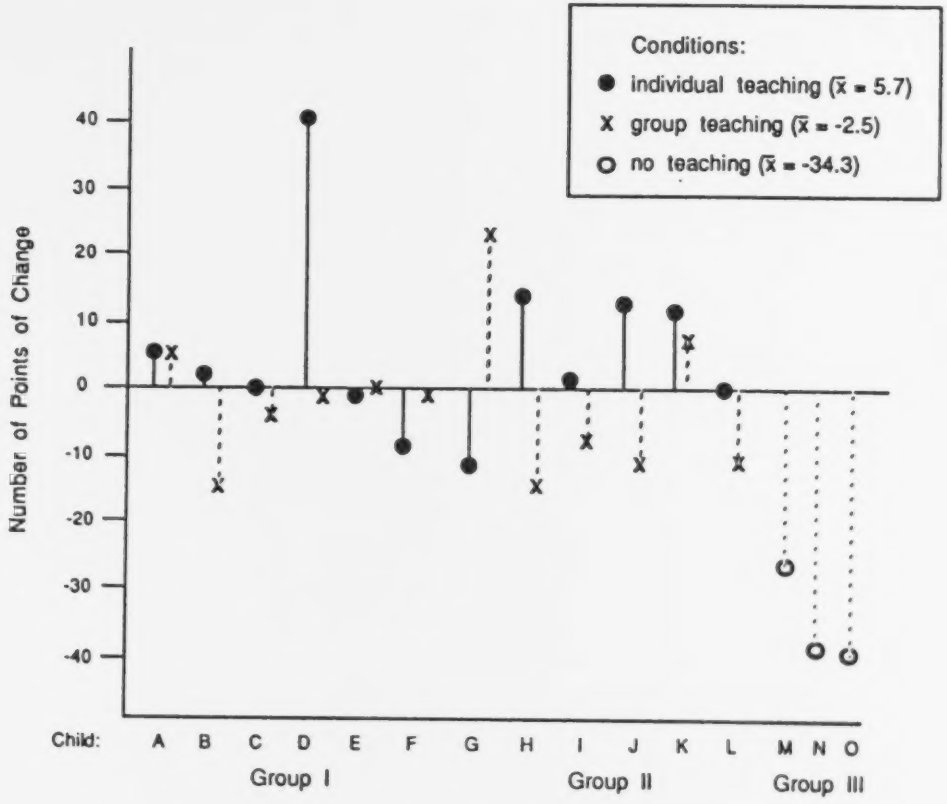
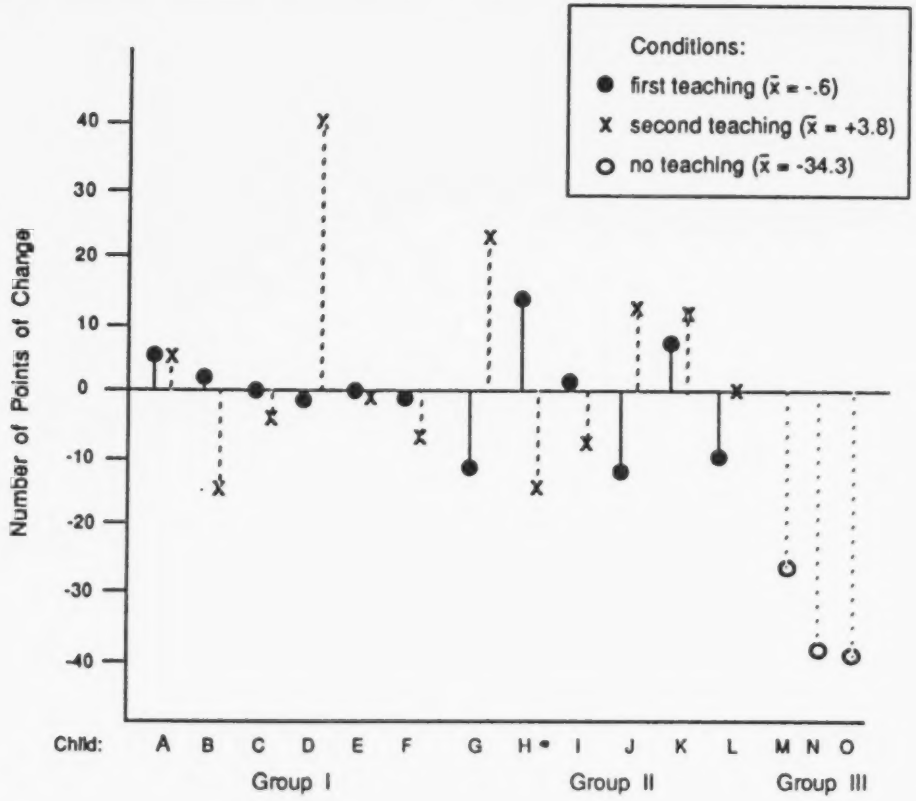


Figure Caption

Figure 7. Comparison of the change in total points earned by children in Groups I and II following their first and second set of teaching sessions, and the change in total points earned by children in Group III from their first to fifth pretests.

CHANGE IN TEST SCORES: FOLLOWING FIRST AND SECOND TEACHING CONDITIONS



to the children showed an average score of 24.8 points, an increase of 4.3 (21.0%).

Children of experimental Group I, who received only one pretest before their first teaching session, scored an average of 23.8 points on this pretest. This average was increased to 24.7 points (an increase of .9 points, 3.8%) on the first posttest and again to 27.8 points (3.1 points, 12.6% more) on the second posttest.

Comparison by expressive language level. Children from the three expressive language levels (high, medium and low) were included in each of the small groups for group teaching. The changes in points earned were compared among these groups. Of the twelve children in the experimental groups, the four children in the High expressive language level all increased their test scores after one set of teaching sessions, and one child (Child A) earned more points following both of her teaching experiences. Two of the four children at the Medium expressive language level earned more points after one set of teaching sessions and another child earned more points after both sets of teaching sessions. Only one child at the Low expressive language level earned one more point on a posttest than on the average of his pretests. The other three children from this level earned the same number of points or fewer points on both of their posttests.

Comparison by sex. Five boys and seven girls comprised the experimental group of this study. Half of the girls' posttest scores increased by at least one point, while only 30% of the boys' scores were higher following their teaching sessions. Two girls (Child A and

Child K) earned more points on both of their posttests. Three other girls (Child B, Child G, and Child H) earned more points on one of their tests while the other two (Child E and Child L) earned the same number of points on one posttest and fewer points on the other. One boy (Child F) scored fewer points on each of his posttests and another boy (child C) earned the same score on one posttest and lower on the other. The other three boys (Child D, Child I, and Child J) earned more points on one posttest and fewer points on the other.

Comparison by problem. The fifteen children scored an average of 23 to 31 points on nine of the ten problems presented to them. Only on Problem 8 did the children earn noticeably more points (38). Figure 8 illustrates the range of points earned across all conditions for each problem and the average number of points earned per problem.

Individual Data

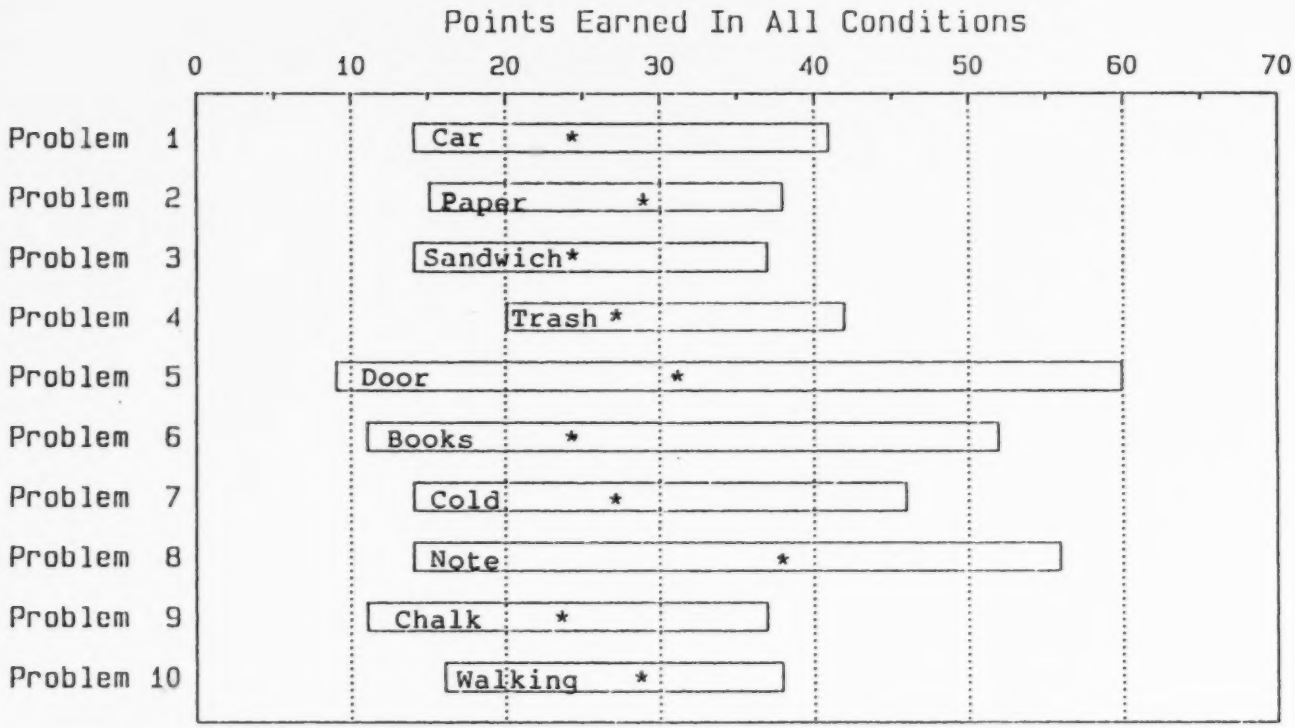
The children involved in this study were definitely individuals as was evidenced by the variety of possible solutions offered and the wide range of scores earned across all conditions. The results discussed, however, relate to the number of possible solutions offered and the number of points earned during the testing sessions only. A set of graphs, Appendix E, illustrates the number of solutions generated and the total points earned by each child in each of the conditions.

Possible solutions. The first problem-solving skill addressed in the teaching sessions was the generation of possible solutions.

Figure Caption

Figure 8. Comparison of the range of points earned for each problem presented to the children. Problems were randomized across all teaching and testing conditions.

RANGE OF POINTS EARNED PER PROBLEM



* Mean Points Earned

Because of the limited time available for the experimental sessions (30 minutes), children were allowed to offer up to ten solutions. The number of possible solutions offered ranged from one to ten, with a mean of 3.7 for all testing sessions. Two children offered ten solutions during one of their testing sessions: Child D during his last posttest session following individual teaching and Child I in his first pretest session. Six children offered only one possible solution during at least one of their testing sessions. Child K offered one possible solution during her first pretest. Child H suggested only one during her second and third pretests and Child N offered one on his fifth pretest. Child G and Child L each offered one possible solution during their first posttest (following individual and group teaching, respectively). One child (C) offered only one solution during her pretest and both of her posttest sessions. Table 4 illustrates the number of possible solutions offered by the children during testing sessions.

Total points earned. Children earned points reflecting their performance of problem-solving skills on each of the problem-solving sessions. As stated earlier, they received one point for each possible solution generated, one point for each green check awarded during the evaluation process, five points for selecting the possible solution with the most green checks to implement , and three points for selecting a possible solution which solved the problem. The number of points earned in all testing sessions ranged from 11 to 60 points with a mean of 25.1 (the mode is 20 and median is 23). Child

Table 4

Possible Solutions Generated in Testing Sessions

GROUP #	CHILD	PRETESTS	POSTTEST I		POSTTEST II	
			IND	GRP	IND	GRP
Ia	A	3	2			5
Ia	B	6	8			5
Ia	C	1	1			1
Ib	D	4		2	10	
Ib	E	2		2	3	
Ib	F	4		4	4	
IIa	G	6,2,2	1			5
IIa	H	4,1,1	4			2
IIa	I	10,5,3	3			3
IIb	J	2,4,4		3	5	
IIb	K	1,3,3		3	5	
IIb	L	4,4,2		1	3	
III	M	7,3,4,3,3				
III	N	7,5,2,4,1				
III	O	8,5,4,8,2				

D earned a total of 60 points on his final posttest, following individual teaching, which was also the greatest increase in points earned (40 points or 200%). The fewest number of points earned was 11. Three children, Child C, Child K, and Child N, each earned only 11 points on one of their testing sessions. Table 5 illustrates the number of points earned by each child in the testing sessions.

Discussion

Though most research on problem-solving has been with persons above preschool age, some has been conducted with very young children using unstructured procedures. The present research with preschool children on generating and selecting solutions to problems incorporated a structured evaluation procedure. This evaluative structure, and its use by the children, was a distinctive characteristic of this study, as were the atmosphere of success, data collection on teacher behaviors, and group vs. individual teaching methods. Following the interpretation of these factors, I will discuss the relationship of the experimental groups to a comparison group, the relative effectiveness of the instruction for children of different language levels, the possible effects of weather and novelty on the results, and the practical application of the study. As described in the results, the sex of participating children and the specific problem presented did not have an impact on children's performance and, therefore, will not be further discussed.

Table 5

Points Earned in Testing Sessions

GROUP #	CHILD	PRETESTS	POSTTEST I		POSTTEST II	
			IND	GRP	IND	GRP
Ia	A	15	20			25
Ia	B	41	43			28
Ia	C	14	14			11
Ib	D	21		20	60	
Ib	E	20		20	19	
Ib	F	32		31	24	
IIa	G	33,17,17	11			34
IIa	H	26,13,14	32			18
IIa	I	31,25,19	26			18
IIb	J	20,30,32		15	28	
IIb	K	11,23,20		25	37	
IIb	L	28,29,16		14	14	
III	M	49,24,21,15,23				
III	N	49,34,20,21,11				
III	O	56,36,24,47,17				

Evaluation process

The children indicated that they had "learned" the use of the evaluation chart during the teaching sessions by stating the criteria as I pointed to the illustrations at top of the chart and by making the checks in the appropriate boxes. In almost every testing session, children chose to have their possible solutions written on the large chart rather than on my data sheet. However, when given the opportunity (offered the red and green markers) to evaluate their possible solutions during the posttest sessions, very few of them made any attempt to do so. A few children took the markers and colored in the illustrations at the top of the chart. Only two children used the chart in a way similar to the use demonstrated.

Child K evaluated her possible solutions on her final posttest, following individual teaching, by considering each possible solution and some of the criteria. When I read the first possible solution she responded, "It is dangerous: red check!" then, "If it's easy or hard ... hard, hard, hard!" and made five red checks. After the second possible solution she again said, "If it's dangerous ... hard or easy ... slow or fast!" and made five green checks. For each of the remaining three possible solutions she responded, "Easy, easy, easy, easy, easy!" and made five green checks. This child was a part of Group IIb. She was four years, three months old at the beginning of the study and ranked in the middle expressive language group. She attended the morning preschool class and was, therefore, only acquainted with me through the study and my occasional visits to her classroom.

Child D, on the other hand, was more familiar with me because he attended the afternoon preschool class in which I was the head teacher. He was five years, two months old when the study began and was ranked in the high expressive language group. The circumstances of his last individual teaching and final posttest sessions were markedly different than those of the other children participating. Because of family illnesses and travel, he was absent from preschool the last month of classes. When his family returned to town, I made arrangements for him to meet with me on two successive mornings to work on problems and then play outside for a short time. He was most eager to work and attended to the problem and my instructions carefully during the teaching session. When he returned the next day for the final posttest, he was again very eager to cooperate. He offered ten possible solutions. When I offered him the red and green markers, he worked with the chart, repeating each of the criteria aloud and making red and green checks as he evaluated the first two possible solutions. The remaining eight possible solutions were quickly evaluated in a manner similar to that used by Child K, making all red or green checks for the solutions he felt were "bad/good, hard/easy, or slow/fast." After marking all the possible solutions, he said, "Let's count how many!" He differentiated between the ones with red checks and those with green checks and asked me to read only those he had marked with five green checks. From those three, he selected a best solution which he implemented.

These two children who did use the evaluation chart during their posttest sessions seemed to have very little in common other than their eagerness to learn and participate in the problem-solving. The reasons that other children did not demonstrate the use of the evaluation chart are not readily apparent. However, the children may have needed more than two teaching sessions to really learn the use of the evaluation chart during a posttest situation in which the teacher was no longer leading them through the process.

Atmosphere of Success

One of my priorities in this study was that every child feel successful during each session. Therefore, we "worked together" to ensure that each testing or teaching problem was resolved to their satisfaction. None of the criteria used to evaluate the possible solutions addressed whether the possible solution would, in fact, "solve" the problem. Because I felt that this type of criterion would be too abstract for the children to understand, I intentionally omitted it from the evaluation chart. However, we "solved" each problem even if I had to give an extra boost or the child adapted his or her solution until satisfied with the results. Everyone won every time!

Teacher Behaviors

Reliability data were collected during 16 sessions on five different teacher behaviors as earlier stated. The reliability of four of these teacher behaviors (all except teacher instruction) varied greatly, from 0 to 100%. I feel this was due, in great part, to the difficulty I had recording the volume and diversity of my own

behavior while working with one or more children. The greatest difference in teacher behavior between the teaching and testing sessions was the number of specific prompts for possible solutions and the number of verbal praise statements given (for evaluating the possible solutions). I had more to say, more to do, and more data to record during the teaching sessions. As a teacher, I focused on the children's learning process and, consequently, recording was affected.

The reliability for two teacher behaviors, neutral prompts (P) and verbal praise (V) was calculated to be at 50% or higher during all of the sessions when the reliability observer was present. Each of these behaviors occurred quite frequently during all sessions. However, accurately recording the two other teacher behaviors, specific prompts (S) and non-verbal praise (N), was more difficult. The reliabilty of non-verbal praise was at or below 50% for half of the sessions during which the reliability data were collected. The number of times that I smiled (scored as non-verbal praise) was most difficult for me to record consistently. During two sessions, I recorded one specific prompt that the reliability observer recorded as a neutral prompt. Because the observer did not record any specific prompts during those sessions, the reliability was 0% for this teacher behavior.

Children's Performance

Group vs. individual teaching sessions. While children typically earned more points during their group teaching sessions than during any other session, the type of possible solutions offered

during these sessions was notably different from those offered when children worked individually with me. During group teaching, children offered many possible solutions which varied only slightly from one another (i.e., four or five different ways to cut bread when making a sandwich; small books on top shelf, medium books on middle, and large books on bottom--medium on top, big on bottom, little on middle--big on top, medium on middle, little on bottom, etc.). During individual teaching children offered more unique solutions (i.e., "Go to the store and get another piece of bread!"; erase the chalk marks "When I grow up!"; or posting the note to parents "up on the light . . . Moms and Dads would have to do this!" from the child lying his on back).

Another difference in the teaching methods was the length of time required to complete the sessions. Typically, the group teaching sessions took the entire 30 minutes of outdoor time while some individual teaching sessions were only 15 minutes long. These group sessions were also more tiring for the teacher, who attempted to attend to each child and to negotiate consensus agreements upon each of the evaluation criteria and final solution to be implemented.

Children in the groups tended to agree upon the evaluation of the possible solutions immediately or not at all. Seldom were children willing to listen to another child's opinion about a specific criterion and they were even more reluctant to accept another child's solution as the one to implement. As the teacher, I tried to guide and moderate the evaluation discussions but often I made the decision that no

consensus would be reached and made a red or green check so we could continue with the process.

Comparison group. The declining trend of scores of the comparison group, who received only pretests, implied that learning to solve problems is more complicated than the idea that "practice makes perfect." One possible reason for this decline in scores was that the children received little information from the teacher on their performance. Though each session ended with the child receiving praise and a written award, the children were never given descriptive praise that indicated what they had done that was praiseworthy.

Secondly, children may have received criticism from their parents, siblings, or other peers when they described the possible solutions they had offered during the sessions. Because some of their solutions were impractical (e.g., making a car and driving it across the room; using gum to stick two pieces of paper together, or building an igloo in the room to keep warm) others may have discouraged them from generating many creative solutions. During the teaching sessions, children were encouraged to offer "all kinds" of solutions and each one was evaluated as a valuable solution.

Although I overheard no conversations between preschoolers who participated in the study regarding the problem-solving tasks, children in the comparison group may have compared their experiences with those of the children in the experimental groups. The children in the comparison group did indicate an interest in the

purpose of the chart on several occasions during the pretest sessions but voiced no frustration in not knowing how to use it.

Expressive Language Level. A connection between the "talkativeness" of children during the language screenings and their willingness or ability to generate possible solutions was seen. Although children in the low language level typically offered many possible solutions during their pretests, children in the high and medium levels offered more possible solutions and earned more points following both individual and group teaching than did those in the low language level. Included in the low language group of children was one child with a hearing aid (worn only part of the time), one child enrolled in private speech therapy, and another who had been the subject of an intervention program the previous semester to increase the volume of his speech. Although none of these conditions precluded these children participating in regular preschool activities, they may have impeded the children's problem-solving performance, which was based on verbalizing their ideas. All screenings and the problem-solving sessions were conducted by the same teacher. The degree to which children felt comfortable talking with her may have contributed to their MLU and problem-solving scores.

Weather. The weather may have influenced the children's performance in two different ways. Because all sessions were conducted during the outdoor time of the preschool day, some children expressed a desire to join their classmates outside on sunny days, especially as the temperature warmed and spring arrived. The

children in Group III, the comparison group, and Group Ib worked on their problems during the last weeks of March and through April when the greatest changes in weather occurred. Five of these six children earned fewer points during successive testing sessions as the spring weather warmed. In another case, the child, his mother and I arrived at a compromise that mother would pick him up later on the days that he "worked with me" so he and I would play outdoors together after finishing our work. Other children seemed unaffected by the weather and checked with me daily to see if it was their turn to work with me.

The weather also affected the possible solutions that children offered for one of the problems: If you feel cold at school, what can you do to feel warmer? In the first few cold months, children remembered that they had coats, hats, mittens, etc. for playing outside and some offered these as possible solutions. When the temperature was much warmer in the spring, children suggested going outside to warm up. All of the solutions were quite plausable and acceptable for the time of year offered.

Novelty. Another factor that may have affected the children's performance on the problem-solving tasks was the novelty effect. While some of the children were eager to participate each time I approached them to stay inside with me, others were less enthusiastic after the second or third session. Although each session presented a different problem, the procedures used to solve the problems were similar in all conditions. This was especially true for the children in

Group III who received five pretests and whose scores were increasingly lower with each session. Conversely, some children found repeatedly "helping poor Marie fix her problems" very challenging and apparently rewarding, as indicated by their scores and comments made to parents.

Practical application

Teaching problem-solving skills to preschool children would seem a worthwhile expenditure of teacher time and effort, considering the number of problems which present themselves to people throughout their lives. These skills might be taught during a specific time of the day to the entire class, integrated into other teaching activities or while working with individual children as they encounter problems in their everyday activities. Several components of this study lend themselves to use in the typical preschool classroom.

Frequent and regular use of problem-solving skills in the classroom would encourage children to identify and solve their own problems. The problems used in the study were ones which could be found (or staged) in most classrooms but children could also offer problems that they encountered during the day at preschool. The chart could be easily reproduced or drawn on a chalkboard for use with a single problem. Although the children generally responded very positively to the individual teaching sessions, it is not feasible to have one teacher and one child in the classroom alone. However, teaching small groups of children proved to be lots of fun and somewhat effective. When working with a group of children in the classroom

(rather than for research) it would not be necessary to reach a consensus on the evaluation of each criterion nor on the solution to implement, but might offer the opportunity to experience the democratic principle of "voting".

Further research into the teaching of problem-solving skills to children at this age level is still needed. Proposals for this include:

(a) offering more than two teaching sessions to children before evaluating the effectiveness by giving a posttest,

(b) conducting problem-solving activities at different times of the day or as problems arise in the classroom,

(c) using different criteria in the evaluation process and/or an alternative "chart" that is more descriptive of the criteria chosen for the specific group of children targeted,

(d) encouraging children to identify problems from their own experiences, and

(e) teaching skills to larger groups (whole classes) of children.

Although many factors influenced the children's performance in this study, they did, in fact, solve a variety of problems successfully. The group teaching sessions, while exhausting for the teacher, proved stimulating for the children. The individual teaching sessions also encouraged children to consider and evaluate somewhat more creative possible solutions and enabled several children to increase their scores on the posttest which followed. Many of the

testing sessions were greeted with enthusiasm by the children. However, most unexpected was the evidence that opportunities to pratice, without benefit of instruction in a problem-solving strategy, did not increase children's scores. Furthermore, practice alone actually led to successively lower scores.

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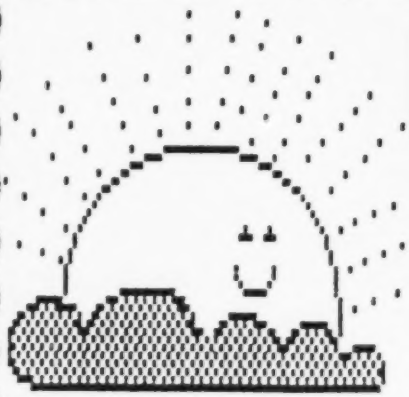
Appendix A



PROBLEM SOLVERS AT WORK

PLEASE GO OUT THROUGH ROOM ACROSS HALL

PROBLEM SOLVERS AT WORK

PLEASE USE OTHER DOOR

Appendix B

Marie Summers
Spring, 1987

Child:_____

Session:_____
Date:_____

Pretest/Posttest
Solutions -
Green -
Best Sol. -
Solves Prob -
TOTAL -

Problem:

_____

_____

Teaching Problem Solving Strategy to Preschoolers

____ TEACHER, I have a job we need to get done. Let's work together and figure out how to do it. This is our problem (state problem)

____ CHILD restates problem

____ TEACHER, Now we are going to think of all the ways we could get our job done. You can use any part of your body, anything in our room, anything you can imagine to do this. I need to write down all of your ideas. Shall I write them on this big paper or on my little paper here?

____ CHILD responds

SOLUTIONS LISTED ON CHART OR BELOW

P S V N _____

P S V N _____

P S V N _____

P S V N _____

P S V N _____

P S V N _____

P S V N _____

P S V N _____

P S V N _____

P S V N _____

If only one solution is generated:

____ TEACHER, You told me one way to do our job. Is it the best way you can think of?

____ CHILD RESPONDS

If more than one solution is generated:

____ TEACHER, Now you need to decide which of these ways is the very best. You may use these markers if you would like. Do you want me to read your ideas to you again?

____ CHILD responds affirmative

V N ____ TEACHER reads ideas

____ CHILD uses red and green markers

V N ____ TEACHER, Which one of these is the best way to (state problem)?

____ CHILD selects one solution

OR

____ CHILD responds negative

V N ____ TEACHER, Which one is the best way to (state problem)?

____ CHILD selects one solution

____ TEACHER, You have decided that the best way to (state problem) is for you to (state solution). Let's see if it really works.

____ CHILD implements the chosen solution

V N A TEACHER gives recognition

Marie Summers
Spring, 1987

Individual Teaching
Solutions -
Green -
Best Sol. -
Solves Prob -
TOTAL -

Session:_____
Child:_____ Date:_____

Problem: _____

_____

Teaching Problem Solving Strategy to Preschoolers

____ TEACHER, I have a job we need to get done. Let's work together and figure out how to do it. This is our problem (state problem)

____ CHILD restates problem

____ TEACHER, Now we are going to think of all the different ways we could get our job done. You can use any part of your body, any- thing in our room, anything you can imagine to do this. You tell me your ideas and I'll write them down right here so we won't forget any of them. (Child's name), what is your first idea?

____ TEACHER, Now we are going to think about each of your ideas. We need to decide if we should go with the idea and give it a green check, or stop with the idea and give it a red check. One green check does not mean it is great and one red check does not mean that it is bad, but the checks will help us decide what idea is very best.

SOLUTIONS OFFERED	EVALUATION A	B	C	D	E
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R

A -- If we (state solution), would it be safe or could someone be hurt?
B -- Do we have everything we need to do it this way, or do we need to get something more?
C -- Do you think you could do this all by yourself, or would you need a grown-up to help you?
D -- Would it take a long time or a short time to do this?

E -- Would this be pretty easy for you to do, or hard?

____ ____ ____ ____ ____ TEACHER, Why do you think that this would be _____ (if teacher feels child has chosen incorrect check).

____ TEACHER, We have now checked out all of your great ideas. We need to figure out which one would be the best for you to do. Look at all of the checks on this paper! Remember, the green means ...
____ CHILD responds "Go"
____ TEACHER, and the red means ...
____ CHILD responds "Stop"

____ TEACHER, You can count the green checks beside each of your ideas to find out which one is the very best.

____ CHILD counts green checks
___V N TEACHER records total number of green checks

____ TEACHER, Which idea has the <u>most</u> green checks?
____ CHILD selects "best" solution
V N TEACHER gives praise

____ CHILD selects solution other than "best"
____ TEACHER recounts green checks with child
____ TEACHER counts red checks with child
____ CHILD selects "best" solution
V N TEACHER gives praise

____ TEACHER, We have decided that the best way to (state problem) is for you to (state solution). Let's see if it really works.
____ CHILD implements the chosen solution

_____ TEACHER, Let's check our chart again.
_____ Was it really safe?
_____ Did we have everything we needed?
_____ Did you do this all by yourself?
_____ Did it take a short time?
_____ Was it easy to do?

_____ Did it really (state problem)?

V N A TEACHER gives recognition

Marie Summers
Spring, 1987

Child:_____ Session:_____ Date:_____

Group Teaching
Solutions -
Green -
Best Sol. -
Solves Prob -
TOTAL -

Problem:

_____

Teaching Problem Solving Strategy to Preschoolers

___ TEACHER, I have a job that we need to get done. Let's all work together and figure out how to do it. This is our problem (state problem). What is it that we need to do?
___ V N First child restates problem
___ V N Second child restates problem
___ V N Third child restates problem
___ TEACHER, Now we are going to think of all the different ways we could get our job done. You can use any part of your body, anything in our room, anything you can imagine to do this. You tell me your ideas and I'll write them down right here so we won't forget any of them. How could we do this?

___ TEACHER, Now we are going to think about each of your ideas. We need to decide if we should go with the idea and give it a green check, or stop with the idea and give it a red check. One green check does not mean it is great and one red check does not mean that it is bad, but the checks will help us decide what idea is very best.

SOLUTIONS OFFERED	EVALUATION A	B	C	D	E
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R
_____	P S V N	_V N G/R	_V N G/R	_V N G/R	_V N G/R	_V N G/R

A -- If we (state solution), would it be safe or could someone be hurt?
B -- Do we have everything we need to do it this way, or do we need to get something more?
C -- Do you think you could do this all by yourself, or would you need a grown-up to help you?
D -- Would it take a long time or a short time to do this?
E -- Would this be pretty easy for you to do, or hard?

___ ___ ___ ___ ___ Problem-Criteria group discussed before
___ ___ ___ ___ ___ reaching agreement.

____ TEACHER, We have now checked out all of your great ideas. We need to figure out which one would be the best for you to do. Look at all of the checks on this paper! Remember, the green means ...
____ CHILDREN respond "Go"
____ TEACHER, and the red means ...
____ CHILDREN respond "Stop"

____ TEACHER, You can count the green checks beside each of your ideas to find out which one is the very best.
____ CHILDREN count green checks
____ TEACHER records total number of green checks

____ TEACHER, Which idea has the most green checks?

_____ EACH CHILD selects "best" solution
V N TEACHER gives praise

_____ CHILDREN select solution other than "best" or do not agree upon one solution
_____ TEACHER recounts green checks with children
_____ TEACHER counts red checks with children
_____ TEACHER and CHILDREN discuss solutions
_____ CHILDREN reach agreement upon "best" solution
V N TEACHER gives praise

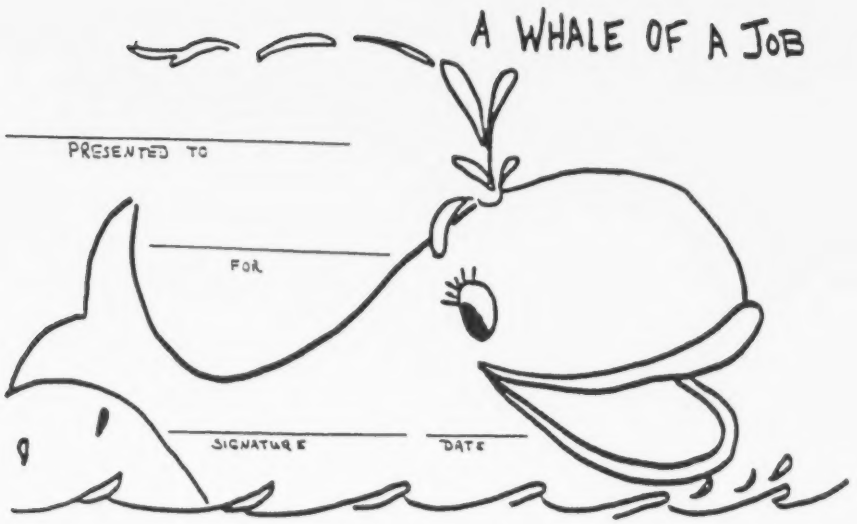
____ TEACHER, We have decided that the best way to (state problem) is for you to (state best solution). Let's see if it will really work.
____ CHILDREN implement the chosen solution

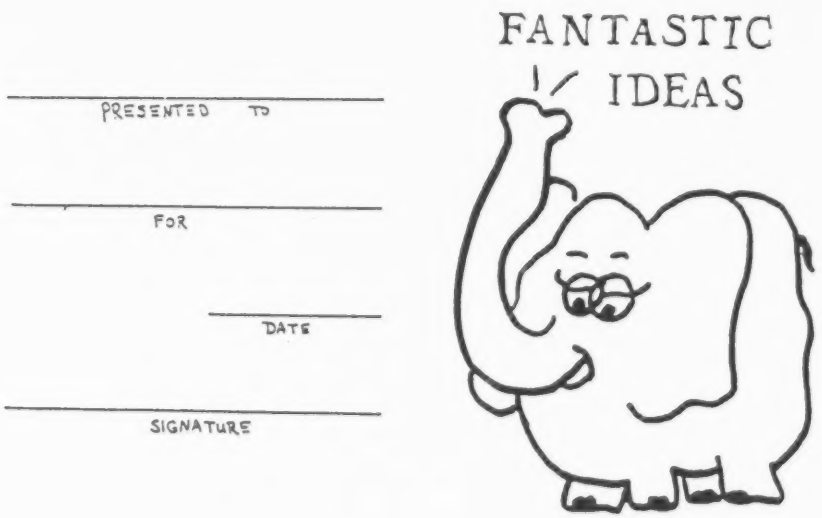
____ TEACHER, Let's check our chart again.
_____ Was it really safe?
_____ Did we have everything we needed?
_____ Did you do this all by yourself?
_____ Did it take a short time?
_____ Was it easy to do?

_____ Did it really (state problem)?

V N A TEACHER gives recognition.

Appendix C


A WHALE OF A JOB
PRESENTED TO
FOR
SIGNATURE
DATE


FANTASTIC IDEAS
PRESENTED TO
FOR
DATE
SIGNATURE

Appendix D

TEACHING PROBLEM-SOLVING SKILLS

This study compared two strategies for teaching problem-solving skills to preschool children. The two strategies involved teaching children individually and in small groups of three. The problem-solving skills emphasized were generating solutions and evaluating those solutions. Two groups of three children each participated in 1 pretest, 2 individual teaching sessions, 2 group teaching sessions, one posttest session between the two different types of teachings and a final post test. One group received group teaching first and the other received individual teaching first. Two groups of three children participated in three pretests followed by the same teaching, and posttest sessions listed above. Again, the order of teaching strategies was different for the two groups. Three children in another group were given five pretests followed by one group teaching session. Data were recorded on one of three data sheets specifically designed for Pretest/Posttest, Individual Teaching, and Group Teaching.

Participating children were selected from the students enrolled in either the morning or afternoon classes conducted at the Regents Center Child Development Laboratory Preschools. Sessions were held in the classroom while the rest of the children and staff

were out of the room during outdoor time, 11:00 to 11:30 am or 3:00 to 3:30 pm.

All testing and teaching sessions began with the teacher introducing a problem to the child or children. PROBLEM was defined as a teacher-stated task to be accomplished by the child(ren).

Examples: There is a little car stuck under the refrigerator and we need to get it out.

We need to get these two pieces of paper to stay together.

We need to clean off the chalk marks at the top of the chalkboard.

The teacher stated the problem and had the child repeat the problem to ensure that the child did, in fact, understand the task to be accomplished. These statements were recorded as having been completed with a check (✓) on the data sheet.

The teacher then instructed the child(ren) to offer any possible solutions to the problem by reading a prepared statement from the data sheet. (The completion of this step was also recorded with a check <✓> on the data sheet.) POSSIBLE SOLUTION was defined as a verbal description of any particular action that could be taken to solve the problem regardless of the feasibility of that action.

Examples: We could reach way under with our hands.

We could put some glue on the back.

We could get a ladder and climb up with an eraser.

After each possible solution was offered, the teacher gave the child neutral and/or specific prompts to generate more possible

solutions. These prompts were recorded on the data sheet as they occurred. NEUTRAL PROMPT (P) was defined as a verbal acknowledgement of the child's response which encourages another response without providing any additional information.

Examples: Uh-huh

What else?

What's another way?

SPECIFIC PROMPT (S) was defined as a verbal encouragement for another response that provides suggestions of categorical actions, materials, or location of materials that might be used to solve the problem.

Examples: Can you think of a way to use some furniture that would help?

Would there be something on the teacher's desk that might help the note stay up?

Is there something you can add to the chair to make it high enough?

The teacher also gave each child verbal and/or nonverbal praise throughout the sessions. These were also recorded on the data sheets as they occurred. VERBAL PRAISE (V) was defined as any statement or word phrase from the teacher, directed toward the child, which shows approval of the response or action of the child.

Examples: Great!

You worked so quickly!

Thank you for all of your help.

NON-VERBAL PRAISE (N) was defined as any teacher action directed toward the child which shows approval of the response or action of the child.

Examples: Hug

Smile

Head nod

During the teaching sessions, the child(ren) were taught to use a chart for evaluating the possible solutions. They indicated, with red and green checks, the merits of each possible solution, relative to five evaluation criteria. EVALUATION CRITERIA were defined as the following list of questions used to judge the possible solutions, each of which has a preferred and less-preferred polarity.

Would it be safe or could someone be hurt?

Do we have everything we need to do it this way, or do we need to get something more?

Do you think you could do this all by yourself, or would you need a grown-up to help you?

Would it take a short time or a long time to do this?

Would this be pretty easy for you to do, or hard?

GREEN CHECK was defined as the preferred polarity for an evaluation criterion.

It would be safe.

We have everything we need.

You can do this all by yourself.

It would take a short time to do this.

This would be pretty easy for you to do.

RED CHECK was defined as the less-preferred polarity for an evaluation criterion.

Someone could be hurt.

We need to get something more.

You would need a grown-up to help you.

It would take a long time.

This would be hard for you to do.

For the pretesting sessions, the teacher evaluated the possible solutions according to the evaluation criteria. The teacher also re-evaluated the checks made by the child for the possible solutions generated during the posttest sessions.

The next step was for the child(ren) to determine the best solution for the problem. BEST SOLUTION was defined as the possible solution having the most green checks at the end of the evaluation process.

During the testing sessions, when only one solution was offered, the teacher asked the child if that is the best solution and waited for a response. If the child gave more than one solution, the teacher offered to read the solutions and offered the use of red and green markers. The teacher then asked which of the solutions was the best way to solve the problem. All teacher questions and child responses were recorded with checks (✓) on the data sheet.

During the teaching sessions, the teacher asked the child(ren) to select the best solution. They first reviewed the meaning of the red and green checks and counted all of the green checks. The teacher then

restated both the problem and the selected solution. The teacher instructed the child(ren) to implement the chosen solution in the testing sessions or the best solution in the teaching sessions. IMPLEMENTATION OF BEST SOLUTION was defined as the action by the child(ren) to carry out the agreed upon best solution. Again, the teacher's instructions and the child(ren's) actions were recorded with a check (✓) on the data sheet.

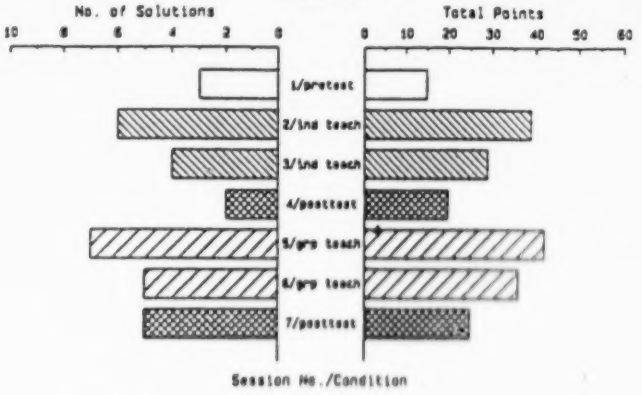
During the teaching sessions the child(ren) were asked to review whether or not their solution actually solved the problem presented to them.

All sessions closed with the teacher giving each child verbal and nonverbal praise and presenting the child with an individualized written award. WRITTEN AWARD (A) was defined as a paper certificate, signed by the teacher, given to the child upon completion of each problem solving session which acknowledges his or her participation.

Appendix E

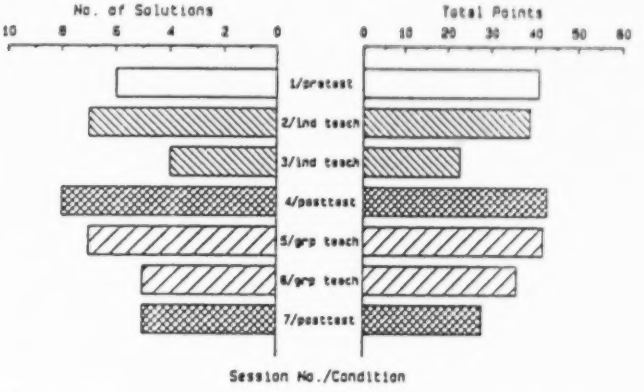
GENERATING, EVALUATING, & SELECTING SOLUTIONS TO PROBLEMS: POSSIBLE SOLUTIONS & TOTAL POINTS

Group Ia



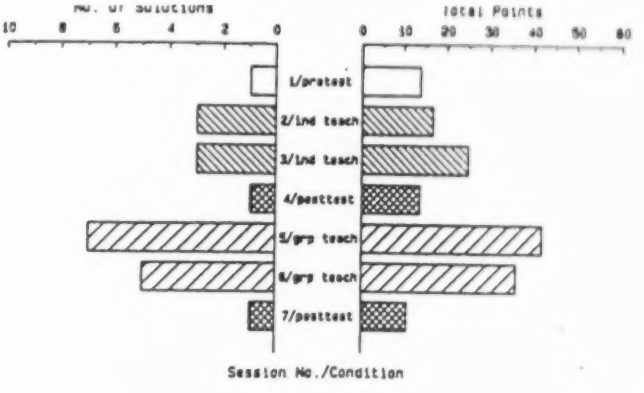
Child A
Exp. Lang. - high
Female / Age 4-4

Avg. test pts. - 20.0
Avg. teach pts. - 36.5



Child B
Exp. Lang. - medium
Female / Age 4-7

Avg. test pts. - 37.3
Avg. teach pts. - 35.0

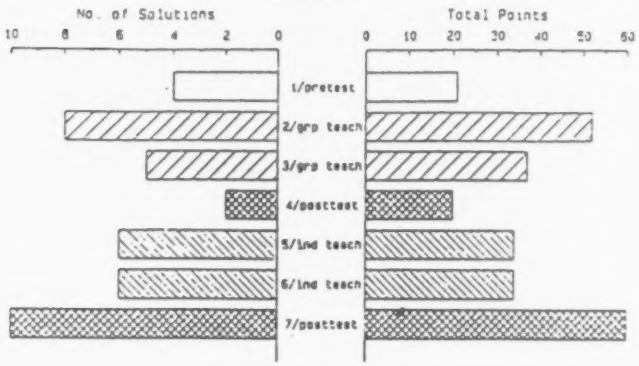


Child C
Exp. Lang. - low
Male / Age 5-0

Avg. test pts. - 13.0
Avg. teach pts. - 30.0

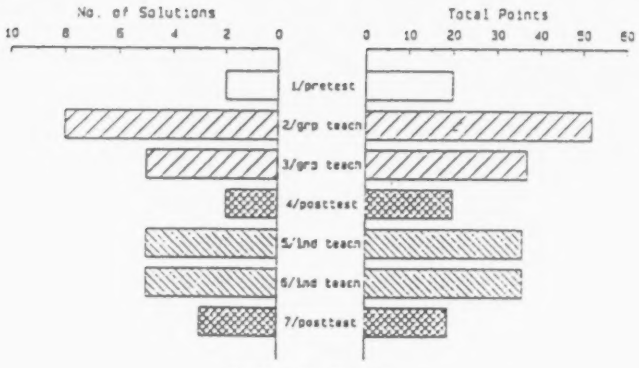
BEST COPY AVAILABLE

GENERATING, EVALUATING, & SELECTING SOLUTIONS
TO PROBLEMS: POSSIBLE SOLUTIONS & TOTAL POINTS
Group Ib



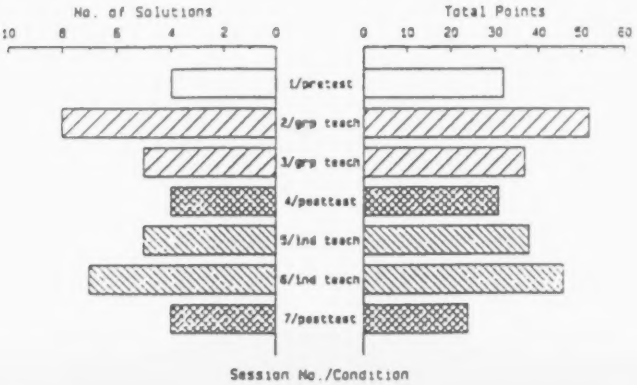
Child D
Exp. Lang. - high
Male / Age 5-2

Avg. test pts. - 33.7
Avg. teach pts. - 39.3



Child E
Exp. Lang. - medium
Female / Age 3-6

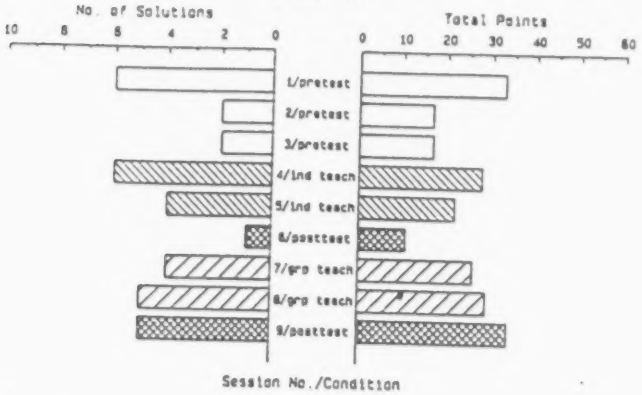
Avg. test pts. - 20.0
Avg. teach pts. - 40.3



Child F
Exp. Lang. - low
Male / Age 5-7

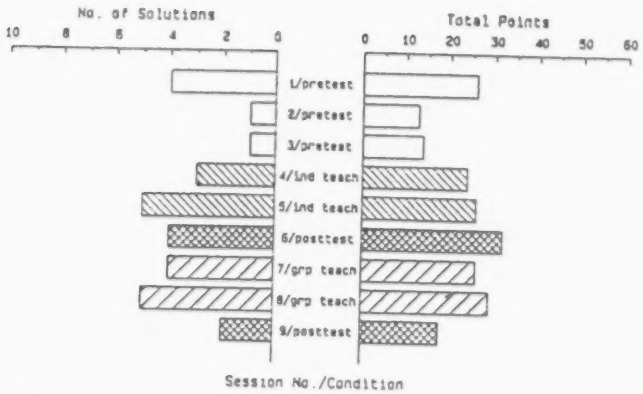
Avg. test pts. - 29.0
Avg. teach pts. - 43.2

GENERATING, EVALUATING, & SELECTING SOLUTIONS
TO PROBLEMS: POSSIBLE SOLUTIONS & TOTAL POINTS
Group IIa



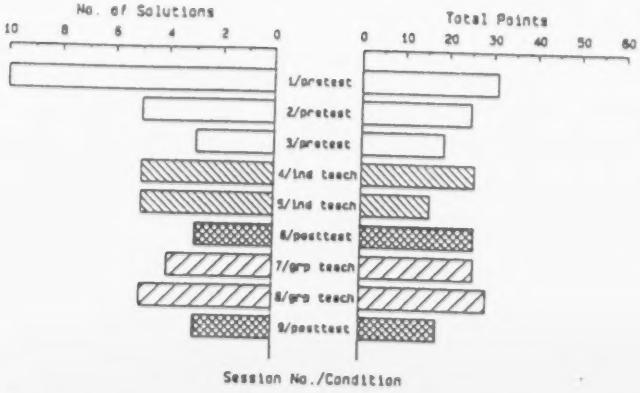
Child G
Exp. Lang. - high
Female / Age 4-0

Avg. test pts. - 22.4
Avg. teach pts. - 28.3



Child H
Exp. Lang. - medium
Female / Age 4-6

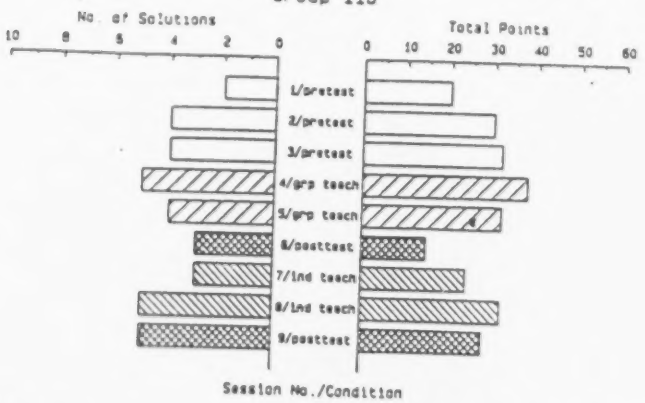
Avg. test pts. - 20.5
Avg. teach pts. - 26.3



Child I
Exp. Lang. - low
Male / Age 4-10

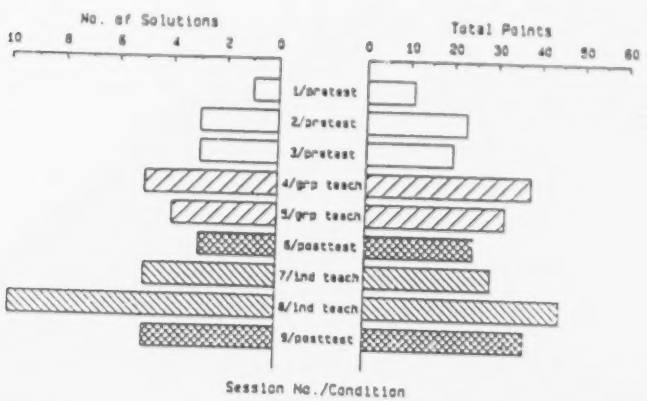
Avg. test pts. - 23.8
Avg. teach pts. - 24.3

GENERATING, EVALUATING, & SELECTING SOLUTIONS
TO PROBLEMS: POSSIBLE SOLUTIONS & TOTAL POINTS
Group IIb



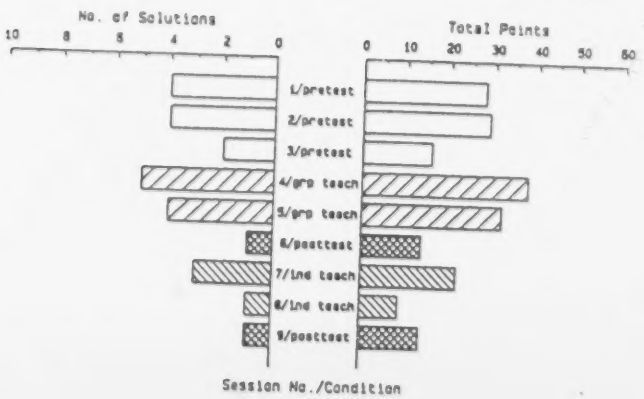
Child J
Exp. Lang. - high
Male / Age 4-0

Avg. test pts. - 25.0
Avg. teach pts. - 31.5



Child K
Exp. Lang. - medium
Female / Age 4-3

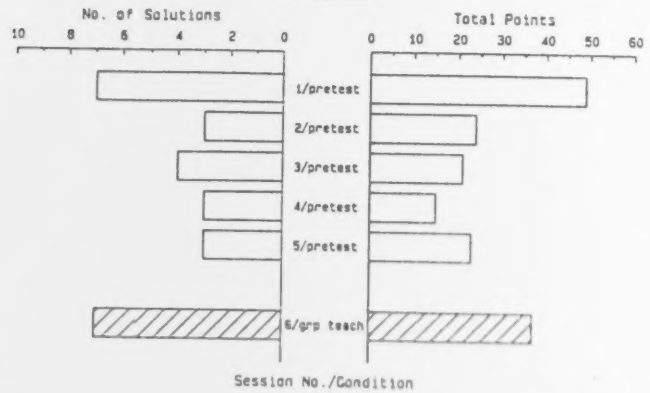
Avg. test pts. - 23.2
Avg. teach pts. - 38.0



Child L
Exp. Lang. - low
Female / Age 5-10

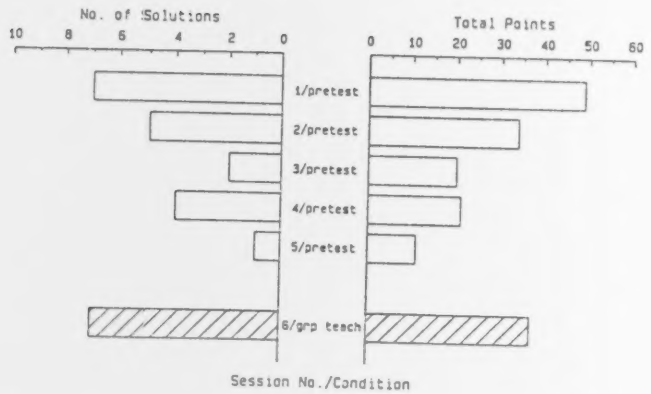
Avg. test pts. - 20.2
Avg. teach pts. - 25.3

GENERATING, EVALUATING, & SELECTING SOLUTIONS
TO PROBLEMS: POSSIBLE SOLUTIONS & TOTAL POINTS
Group III



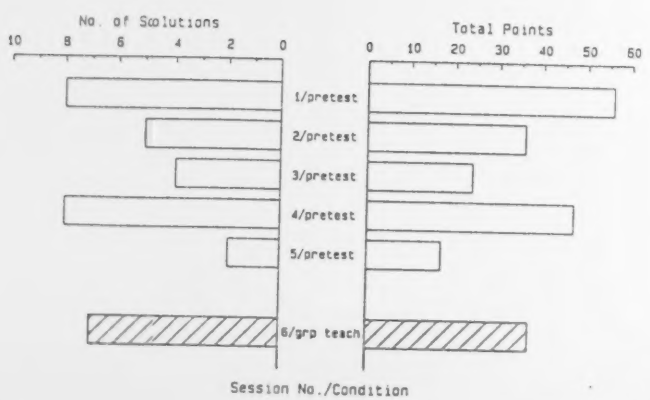
Child M
Exp. Lang. - high
Male / Age 4-10

Avg. test pts. - 25.4



Child N
Exp. Lang. - medium
Male / Age 5-5

Avg. test pts. - 27.0



Child O
Exp. Lang. - low
Female / Age 5-1

Avg. test pts. - 36.0